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Box Patent Application
 Assistant Commissioner for Patents
 Washington, D.C. 20231

Transmitted herewith for filing is the patent application of

Inventor(s): R. Dennis Nesbitt

For (title): Method of Improving Scuff and Cut Resistance of Cover for Game Ball

1. Type of Application - This new application is for a(n) XX Original (nonprovisional) Design

2. Benefit of Prior U.S. Application(s) (35 U.S.C. 119(e), 120, or 121)

- The new application being transmitted claims the benefit of prior U.S. application(s).
 Divisional.
 Continuation.

XX Continuation-In-Part (C-I-P). This application is a continuation-in-part of copending application no. 09/236,848, filed January 25, 1999

3. Papers Enclosed That Are Required for Filing Date under 37 C.F.R. 1.53(b) (Regular) or 37 C.F.R. 1.153 (Design) Application

- 18 Pages of specification
4 Pages of claims
1 Pages of Abstract
 Sheets of drawing formal informal

4. Additional papers enclosed

- Preliminary Amendment Information Disclosure Statement (37 C.F.R. 1.98)
 Form PTO-1449 (PTO/SB/08A and 08B) Citations
 Special Comments Other
 Authorization of Attorney(s) to Accept and Follow Instructions from Representative

CERTIFICATION UNDER 37 C.F.R. 1.10

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date November 22, 1999, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EL445214727US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Laura J. Nolan
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Laura J. Nolan
 Signature of person mailing paper

5. Declaration or oath ☐ Enclosed, but not executed by the inventors.

XX Executed by inventor(s).

legal representative of inventor(s). 37 CFR 1.42 or 1.43.

NOT Enclosed.

6. Inventorship Statement The inventorship for all the claims in this application are: X The same.

7. Language X English ☐ Non-English ☐ The attached translation is a verified translation. 37 C.F.R. 1.52(d).

8. Assignment

XX assignment of the invention to SPALDING SPORTS WORLDWIDE, INC.

☐ is attached with a separate "RECORDATION FORM COVER SHEET -
PATENTS ONLY"

9. Certified Copy Certified copy(ies) of application(s)

Country	Appln. no.	Filed
from which priority is claimed	is (are) attached.	will follow.

10. Fee Calculation (37 C.F.R. 1.16)

A. XX Regular application

CLAIMS AS FILED - OTHER THAN SMALL ENTITY				(11/10/98)
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Total				
Claims (37 CFR 1.16(c))	18 - 20 = 0	x \$ 18.00	\$	
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Claims (37 CFR 1.16(b))	3 - 3 = 0	x \$ 78.00	\$	
Multiple dependent claim(s),				
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11. Small Entity Statement(s)

OTHER THAN SMALL ENTITY: XX

12. Request for International-Type Search (37 C.F.R. 1.104(d))

Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made at This Time

Not Enclosed

No filing fee is to be paid at this time.

X Enclosed

X Basic filing fee

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Recording assignment (See attached "RECORDATION FORM - PATENTS ONLY")
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TOTAL FEES ENCLOSED

\$760.00

14. Method of Payment of Fees

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15. Authorization to Charge Additional Fees

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☒ 37 C.F.R. 1.16(a), (f) or (g) (filing fees)

☒ 37 C.F.R. 1.16(b), (c) and (d) (presentation of extra claims)

☒ 37 C.F.R. 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

☒ 37 C.F.R. 1.17 (application processing fees)

37 C.F.R. 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R.1.311(b))

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Statement Where No Further Pages Added

☒ **This transmittal ends with this page.**

Method Of Improving Scuff and Cut Resistance Of Cover For Game Ball

Related Applications

This application is a continuation-in-part of U.S. Application Serial
5 No. 09/236,848 filed January 25, 1999, which, in turn, is a
continuation-in-part of U.S. Application Serial No. 08/942,653 filed
October 2, 1997, now U.S. Patent No. 5,891,973 issued April 5, 1999,
which is a continuation of U.S. Application Serial No. 08/595,898 filed
February 6, 1996, now abandoned.

10 Background of the Invention

This invention relates generally to game balls, and more
particularly to a game ball, such as a golf ball, having a cover formed
predominantly from a non-ionomer polymeric material.

Before the development of ionomers, balata was the preferred
15 material for golf ball covers. Polyethylene also was proposed for use
as a golf ball cover material but was generally deemed highly inferior to
balata in imparting playability and durability characteristics to the ball
due to its brittleness and high hardness, and thus never became a
commercially successful golf ball cover material.

20 Balata golf ball covers have now been replaced to a great extent
by ionomeric cover materials. Ionomers are copolymers of an olefin and
an α , β -ethylenically unsaturated carboxylic acid with a portion of the
carboxylic acid groups neutralized by a metal ion. The metal ions serve
as crosslinking agents, as they are ionically bonded to carboxylic acid
25 groups in adjacent copolymer chains. Instead of having thermally
irreversible covalent bonding, ionomers have thermolabile crosslinking
bonds in which metal ions become part of the chemical structure of the
ionomer upon crosslinking, and these crosslinks are reversible. For
purposes of this application, this type of crosslinking is referred to as

ionic crosslinking. One of the advantages of ionic crosslinking in golf ball materials is the ability of ionic bonds to re-form after breaking as a result of processing at elevated temperatures.

5 There are numerous advantages to the use of ionomers in making golf ball covers. On the other hand, one drawback of conventional golf balls with soft ionomeric covers are that the covers are prone to scuffing and cutting, particularly when hit with irons which have sharp grooves. It would be useful to develop a golf ball with a soft cover which is highly resistant to cutting and scuffing by sharp-grooved clubs.

10 **Summary of the Invention**

An object of the invention is to provide a non-ionomeric game ball cover having improved scuff resistance and/or cut resistance.

15 Another object of the invention is to provide a method for imparting improved scuff resistance and/or cut resistance to a game ball cover.

Yet another object of the invention is to provide a golf ball with a soft cover which is well-suited for use with golf club irons having sharp grooves.

20 Yet another object of the invention is to provide a method of forming a golf ball with a soft cover which has excellent scuff resistance and/or cut resistance.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

25 The invention in a preferred form is a game ball having a cover comprised predominantly of a non-ionomer resin. The resin advantageously has a sufficient degree of covalent crosslinking to impart to the cover improved resistance to at least one of scuffing and cutting. In a particularly preferred form of the invention, the game ball is a golf ball and, preferably, has a dimpled surface. The covalent

crosslinking preferably comprises peroxide or irradiation-induced covalent crosslinking.

5 In a preferred form of the invention, the degree of covalent crosslinking is appropriate to impart to the cover a Shore D hardness which is no more than about 10% greater, and more preferably no more than about 5% greater, than the Shore D hardness of a cover having an identical composition but which does not include a substantial degree of peroxide or radiation-induced covalent crosslinking.

10 Another preferred form of the invention is a method of treating a game ball. The method comprises the steps of obtaining a game ball having a cover comprised predominantly of a non-ionomer polymeric resin, and irradiating the resin in the cover under conditions appropriate to covalently crosslink the cover material in order to increase the resistance of the cover to at least one of scuffing and cutting without
15 substantially impairing other playability or physical characteristics of the ball. In a particularly preferred form of the invention, the game ball is a golf ball. Preferably, the game ball has a dimpled surface.

Alternatively, the cover material can be formulated with an effective amount of peroxide to achieve the desired crosslinking and
20 improved scuff and cut resistance. The peroxide-containing non-ionomeric polymers are formulated, milled, sheeted and chopped in a typical fashion and used to mold covers on standard golf ball cores. During the molding operation, the cover material is subjected to heat and pressure to effect the curing of the polymeric material.

25 According to the preferred method of the invention, the game ball cover is subjected to gamma radiation treatment at a dosage of at least 2 megarads. The game ball cover preferably is irradiated prior to application of a top coat over the cover. The method of the invention preferably further includes the step of applying a top coat over the cover
30 before or after irradiation.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others and the article possessing the features, properties, and the relation of elements exemplified in the following detailed disclosure.

5 **Brief Description of the Drawings**

Fig 1. shows a golf ball according to the present invention.

Figs. 2 - 3 schematically show one embodiment for practicing the method of the invention.

Detailed Description of the Invention

10 The game balls of the present invention are surprisingly superior in their scuff (abrasion) resistance and cut resistance to conventional game balls which have not been crosslinked, and which contain similar quantities of non-ionomeric compositions, such as polyurethanes, with
15 hardness.

 In accordance with one aspect of the invention, the cover compositions and resulting molded covers of the present invention are manufactured using relatively conventional techniques. In this regard, the compositions of the invention preferably are based on a variety of
20 materials blended together with peroxide crosslinking agents and minor amounts of secondary constituents such as co-crosslinking agents, fillers and the like. Peroxides which are readily available are conveniently used in the present invention, generally in amounts of from about 0.1 to about 10.0 and preferably in amounts of from about 0.3
25 to about 3.0 parts by weight of 40% active peroxide per each 100 parts of base polymer material.

 Exemplary of suitable peroxides for the purposes of the present invention are dialkyl peroxides such as dicumyl peroxide, n-butyl 4,4'-bis

(butylperoxy) valerate, 1,1-bis(t-butylperoxy)-3,3,5-trimethyl cyclohexane, di-t-butyl peroxide and 2,5-di-(t-butylperoxy)-2,5 dimethyl hexane and the like, as well as mixtures thereof. It will be understood that the total amount of crosslinking agent used will vary depending on the specific end product desired and the particular initiators employed. Commercially available peroxides include n-butyl 4,4-bis (butylperoxy) valerate having a one hour half life at about 112°C, and 1,1-bis(t-butylperoxy)-3,3,5-trimethyl cyclohexane having a one hour half life at about 129°C.

In producing golf ball covers utilizing the present compositions, the ingredients may be intimately mixed using, for example, two roll mills or a Banbury® mixer until the composition is uniform, usually over a period of from about 5 to about 20 minutes. The sequence of addition of the components is not critical. A preferred blending sequence is as follows.

The primary polymeric material, crosslinking agent, fillers and the like are blended for about 7 minutes in an internal mixer such as a Banbury® mixer. As a result of shear during mixing, the temperature may rise to about 200°F. The mixing is desirably conducted in such a manner that the composition does not reach incipient polymerization temperatures during the blending of the various components. The batch is discharged onto a two roll mill, mixed for about one minute and sheeted out, following which it is chopped into granular form and molded as half shells. The molding process is carried out preferably at pressures up to 5 tons and temperatures of 200° to 250°C for a heating time of 5 to 20 minutes in the mold.

Usually the curable component of the composition will be cured by heating the composition at elevated temperatures on the order of from about 275°F to about 350°F, preferably and usually from about 290°F to about 350°F, preferably and usually from about 290°F to

about 325°F, with compression molding of the cover composition around a solid core being effected simultaneously with the curing or crosslinking thereof. When the composition is cured by heating, the time required for heating will normally be short, generally from about 2
5 to about 20 minutes, depending upon the particular curing or crosslinking agent used and method of molding. Those of ordinary skill in the art relating to peroxide crosslinking agents are conversant with adjustments of cure times and temperatures required to effect optimum results with any specific composition. The ball is cooled at 50° to 70°F
10 for about 2 to 7 minutes to fuse the shells together to form a dimpled golf ball of a diameter of 1.680 inches or more.

After molding, the golf balls produced may undergo various further processing steps such as buffing, painting and marking as disclosed in U.S. Patent 4,911,451.

15 The preferred fillers are relatively inexpensive and heavy and serve to lower the cost of the ball and to increase the weight of the ball to closely approach the U.S.G.A. weight limit of 1.620 ounces. However, if thicker cover compositions are to be applied to the core to produce larger than normal (i.e. greater than 1.680 inches in diameter)
20 balls, use of such fillers and modifying agents will be limited in order to meet the U.S.G.A. maximum weight limitations of 1.620 ounces. Exemplary fillers include mineral fillers such as zinc oxide, limestone, silica, mica, barytes, lithopone, zinc sulphide, talc, calcium carbonate, clays, powdered metals and alloys such as bismuth, brass, bronze,
25 cobalt, copper, iron, nickel, tungsten, aluminum, tin, etc. Limestone is ground calcium/magnesium carbonate and is used because it is an inexpensive, heavy filler.

The game balls of the invention subject to irradiation are formed by first obtaining an uncoated or coated game ball. An "uncoated"
30 game ball as the term is used in this application is a one, two, or multi-

piece game ball to which no primer or top coat has been applied over the cover. In contrast, a "coated" game ball as this term is used in this application is a ball which has a primer coat and/or a top coat over the cover layer. The coated or uncoated game ball of the invention is
5 subjected to irradiation under conditions appropriate to induce covalent crosslinking of the polymeric cover material. This type of direct covalent bonding has been found to take place in cover materials when peroxides are added to the cover formulation prior to molding or when gamma radiation treatment is applied at a dosage of 2 or more
10 megarads. It is expected to be useful also at lower dosages, for example, 1 megarad.

For clarity of description and ease of understanding, the invention is being described in connection with golf balls although it will be understood that other game balls, including but not limited to softballs,
15 basketballs, baseballs, soccer balls, volleyballs, street hockey balls, footballs, and the like, can advantageously employ the features of the present invention.

Referring now to the drawings, and in particular to Fig. 1, a golf ball according to the present invention is shown and is designated as 8.
20 The ball has a core 10, which is solid, or is formed from any other suitable type of core composition such as a wound core. A cover 12 surrounds the core 10. A thin primer coat 14 is applied to the outer surface of cover 12. A thin top coat 16 surrounds the primer coat 14. The thicknesses of primer coat 14 and top coat 16 are exaggerated for
25 illustrative purposes.

In accordance with the present invention, peroxides are blended into the cover formulation prior to molding or, alternatively, after the cover layer 12 is formed over the core, the cover layer 12 is subjected to irradiation at a dose of about 1 or more megarads in order to
30 covalently crosslink the cover material. Particularly good results are

obtained with less than 10 percent by weight of peroxide and when the irradiation dosage is 2 - 15 megarads. In a most preferred form of the invention, a dosage of 3 - 12 megarads is utilized. As used herein, the term "irradiation" refers to short-duration irradiation using gamma rays, an electron beam or the like, rather than to mere exposure to sunlight, which would result in a dosage of well below 1 megarad. Irradiation takes place at a temperature below the melting or deformation temperature of the cover layer, and for convenience preferably takes place at ambient temperature.

10 The cover 12 can be irradiated prior to or after application of primer coat 14 and top coat 16. Furthermore, primer coat 14 can be eliminated if adhesion of top coat 16 to cover 12 is sufficient to render the ball suitable for competitive play, as is commonly the case with softballs and baseballs, and may also be the case for other game balls.

15 The game ball of the invention can be irradiated with electrons, neutrons, protons, gamma rays, x-rays, helium nuclei, or the like. In a particularly preferred form of the invention, the scuff and cut resistance of cover 12 is enhanced by subjecting the cover to gamma rays or electron beam treatment at a dosage sufficient to significantly improve scuff resistance and COR without excessively hardening the compression or adversely impacting the properties of the core. The game ball preferably obtains an improvement in COR of at least 0.5% as a result of irradiation of the cover.

20 The cover composition preferably contains high quantities of non-ionomer resins. However, the irradiated cover material may have a combination of ionic crosslinks and covalent crosslinks. The polymers typically, although not necessarily, have a Shore D hardness in the range of 20 - 70. It will be appreciated that non-ionomeric materials can be blended with ionomer as long as an acceptable increase in scuff resistance and/or cut resistance is obtained as a result of covalent

25

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crosslinking of the blend. Non-limiting examples of the non-ionomeric materials include ethylene-ethyl acrylate, ethylene-methyl acrylate, ethylene-vinyl acetate, low density polyethylene, linear low density polyethylene, metallocene catalyzed polyolefins such as ENGAGE polyolefins available from Dow Chemical and EXACT polyolefins available from Exxon, (maleated metallocenes which have improved compatibility with the ionomeric material are preferred), polyamides including nylon copolymers such as Nylon 6 and Nylon 66, as well as nylon-ionomer graft copolymers such as CAPRON 8351 available from Allied Signal, non-ionomeric acid copolymers such as PRIMACOR, available from Dow Chemical, and NUCREL, available from DuPont, and a variety of thermoplastic elastomers, including styrene-butadiene-styrene block copolymers such as KRATON available from Shell, SANTOPRENE available from Monsanto, thermoplastic block polyamides such as PEBAX and similar polyester amides, polyurethanes, polyureas, thermoplastic block polyesters, such as HYTREL available from DuPont, functionalized (e.g., maleic anhydride modified) ethylene propylene elastomers such as EPR and EPDM, and syndiotactic resins such as syndiotactic 1,2-polybutadiene alone or in combination with other dienes, such as VCR-412 (Ube pol, Japan) which combines cis 1,4-butadiene with the syndiotactic 1,2-polybutadiene (M.P. 202°C). Other elastomers capable of being crosslinked by irradiation include materials such as acrylic, epichlorohydrin, isoprene-acrylonitrile, nitrile, cis 1,4 polybutadiene, polychloroprene, polyisoprene, natural rubber, silicone, styrene-butadiene and urethane.

In order to obtain the desired Shore D hardness, it may be necessary to add one or more crosslinking monomers and/or reinforcing agents to the polymer composition. Nonlimiting examples of crosslinking monomers which can be used according to the invention are zinc diacrylate, zinc dimethacrylate, ethylene dimethacrylate (e.g., SR-

297, Sartomer Company), trimethylol propane triacrylate. If crosslinking monomers are used, they typically are added in an amount of 3 - 40 parts by weight based upon 100 parts by weight of polymer, and more preferably 5 - 30 parts by weight. A nonlimiting example of a suitable reinforcing agent is fine particle silica, such as HiSil 233 from PPG, Pittsburgh, PA. Reinforcing agents typically are used in an amount of 3 - 60 parts by weight based upon 100 parts by weight of polymer, and more preferably 5 - 50 parts by weight. Coupling agents such as A-172 from Union Carbide of Danbury, CT can be used at a level of about 1% to increase the physical properties of the compound.

If the game ball cover is irradiated prior to application of a primer coat 14 and/or top coat 16, there is no particular restriction on the type of primer coat and/or top coat to be used. If irradiation occurs after application of a primer coat and/or a top coat over the cover 12, it is important to ensure that the radiation will penetrate the coating and that the dosage of radiation is sufficient to covalently crosslink the cover material without adversely affecting the properties of the primer and/or top coat to a substantial degree. Due to the thinness of the primer coat and top coat on most game balls, including golf balls, it has been found that little change in radiation dosage is required if irradiation occurs after application of such coatings.

Golf balls according to the invention preferably have a post-irradiation PGA compression of 10 - 110. In a particularly preferred form of the invention, the golf balls have a PGA compression of about 40 - 100 after irradiation. It has been found that excellent results are obtained when the post-irradiation PGA compression of the golf balls is 60 - 100. The irradiation method of the invention preferably results in an increase in PGA compression of at least 5% as compared to the PGA compression of the ball prior to treatment. The coefficient of restitution of the golf balls of the invention after treatment is at least about .780

or greater. Preferably, the COR of the golf balls is in the range of .790 - .830 and most preferably .800 - .830. The Shore D hardness of the golf balls of the invention after irradiation is in the range of 25 - 80. Particularly good results are obtained when the Shore D hardness of the
5 golf balls is in the range of 30 - 70, and most preferably 35 - 60.

The invention is particularly well suited for use in making dimpled, pebbled, and other game balls which do not have a smooth outer surface, including game balls with simulated stitching. A smooth ball is less susceptible to scuffing than a dimpled ball since dimples give the
10 golf club groove a sharp-edged surface to "catch." Pebbles clearly are susceptible to shearing when dribbled on a hard surface, or the like. Likewise on a molded-cover softball, the stitching is a raised area that will be sheared or compressed more than the smooth-surfaced area by a bat and/or by the turf, dirt, etc.

One embodiment of a method for radiation treating golf balls according to the invention can be described in connection with Figs. 2 and 3. The golf ball 8 is placed on a channel 18 along which it slowly moves. Radiation 20 from a source 22 contact the surface of the ball
15 8. The source is positioned to provide a generally uniform dose of radiation on the entire surface of the ball as the ball rolls along the channel 18. The balls are irradiated with a dosage of 1 or more megarads, more preferably 2 - 15 megarads. The intensity of the dosage preferably is in the range of 1 - 20 MeV.
20

The golf balls of the invention are found to exhibit a scuff
25 resistance in the range of 1 - 3 on a scale of 1 - 4. It is preferred that the treatment be appropriate to provide the golf balls with a scuff resistance of 1 - 2.5, and more preferably 1 - 2. Golf balls according to the invention have a cut resistance in the range of 1 - 3 on a scale of 1 - 5. It is preferred that the golf balls of the invention have a cut
30 resistance of 1 - 2.5 and most preferably 1 - 2.

The scuff resistance test was conducted in the following manner:
a Top-Flite Tour sand wedge with box grooves cut to 0.025" wide with
no post formation sandblasting was obtained and was mounted in a
Miyamae driving machine. The club face was oriented for a square hit.

5 The forward/backward tee position was adjusted so that the tee was
four inches behind the point in the downswing where the club was
vertical. The height of the tee and the toe-heel position of the club
relative to the tee were adjusted in order that the center of the impact
mark was about 3/4 of an inch above the sole and was centered toe to
10 heel across the face. The machine was operated at a clubhead speed
of 58 miles per hour. Three samples of each ball were tested. Each ball
was hit three times and the clubface was brushed clean after each hit.
After testing, the balls were rated from 1 to 6 with 1 being the best and
6 being the worst. A difference of two rankings is considered a highly
15 significant difference.

Cut resistance was measured in accordance with the following
procedure: A golf ball was firmly held in a cavity to expose the top half
of the ball. A guillotine style blade weighing five pounds and having
inner and outer blade edge angles of 90° and 60° respectively and a
20 cutting edge of three sixty-fourths inch radius is dropped from a height
of 3.5 feet to strike the ball at a point one-half inch off the top center
point. The guillotine blade is guided during the drop by means of a
substantially friction-free vertical track.

The cut resistance of the balls tested was evaluated on a scale
25 of 1 - 5.

Rating

Type of Damage

5 A cut that extends completely through the cover to the
core

- 4 A cut that does not extend completely through but that does break the surface
- 3 Does not break the surface but does leave a permanent dent
- 5 2 Leaves a slight crease which is permanent but not as severe as 3
- 1 1 Virtually no visible indentation or damage of any sort

10 It has been found that golf ball covers crosslinked with peroxides or treated according to the irradiation technique of the present invention exhibit a particular improvement in scuff and/or cut resistance. This improvement is particularly significant when the golf balls are struck with a square-grooved iron. It is has been found that square-grooved irons and other sharp-grooved irons tend to abrade and damage golf ball covers more readily than irons having "V-type" grooves.

15 Having generally described the invention, the following examples are included for purposes of illustration so that the invention may be more readily understood and are in no way intended to limit the scope of the invention unless otherwise specifically indicated.

Example 1

A cover material was prepared having the following formulation in parts by weight:

	<u>Component</u>	<u>Amount</u>
5	High styrene content SBR	100
	Precipitated silica	20
	Titanium dioxide	2
	Trimethylol propane trimethacrylate	5
	Silane A-172 coupling agent	0.3

- 10 The high styrene content SBR is a blend of 60% styrene-butadiene and 40% of a high styrene resin.

The material was milled, formed into a sheet and tested for hardness before and after gamma radiation at different dosage levels. The resultant hardness values are set forth in Table 1.

- 15 The material was milled, formed into a sheet having a thickness of 0.130 inch and cut into squares having a size of 2" x 2". Half shells were compression molded using a single female smooth cavity of 1.680" diameter and a 1.624" male smooth cavity. Two resultant half shells were placed around a 1.545" "Z Balata" solid core and placed in
- 20 a dimpled cavity mold for final molding. The resultant balls were tested for scuff and cut resistance using the procedures outlined herein with no irradiation and following six magarads of irradiation. The results are set forth in Table 2.

Example 2

- 25 The procedure of Example 1 was repeated except that the high styrene resin was replaced with a syndiotactic resin, namely VCR412 (Ubepol, Japan), which is cis 1,4-butadiene rubber combined with syndiotactic 1,2 polybutadiene (M.P. 202°C). The resultant hardness

values are reported in Table 1, while the scuff and cut resistance can be found in Table 2.

Example 3

The procedure of Example 1 was repeated except that the
5 formulation was changed to the following:

	<u>Component</u>	<u>Amount</u>
	EPDM Ethylene propylene diene monomer	100
	Precipitated silica	35
	Titanium dioxide	2
10	Trimethylol propane trimethacrylate	10
	Silane -A-172	0.3

The resultant hardness results are reported in Table 1 and the scuff and cut resistance ratings are in Table 2.

		<u>Table 1</u>	
	<u>Cover Material</u>	<u>Dosage (Megarads</u>	<u>Shore D</u>
15	Example 1	3.5	50
		7.0	50
		12.0	52
		0	28
20	Example 2	3.5	25
		7.0	28
		12.0	30
		0	8
25	Example 3	3.5	33
		7.0	35
		12.0	37
		0	13

As indicated in Table 2, the scuff and cut resistance of the balls increased substantially as a result of the irradiation treatment.

Table 2

	<u>Cover Material</u>	<u>Irradiation</u>	<u>Scuff</u>	<u>Cut</u>
5	Example 1	No	4	4
		Yes	2	3
	Example 2	No	3	5
		Yes	2	2
	Example 3	No	2	4
		Yes	1	1
	Commercial ionomer cover control		3	2

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Example 4

A composition similar to Example 3 was prepared but employed a peroxide crosslinking agent and no irradiation. The formula was changed slightly to the following:

	Component	Amount
15	EPDM (Ethylene propylene diene monomer)	100
	Precipitated silica	40
	Titanium dioxide	2.3
	Trimethylol propane trimethacrylate	10
	Silane A-172	0.3
20	1,1-Di(t-butylperoxy)3,3,5-trimethyl cyclohexane	6.0

The composition was blended in a Banbury® mixer, formed into a sheet and chopped into granules. The chopped granules, 6.7 grams, were placed in female hemisphere molds and premolded under 5 tons of

pressure for 12 minutes with heating up to 215°F using a female cavity of 1.680" diameter and a 1.624" male cavity. The resultant shells were molded around a 1.680" Z-Balata" solid core in a dimpled cavity mold at 10 tons of pressure for 8 minutes to a maximum mold temperature of 313°F. The resultant golf balls were trimmed and tested. The balls exhibited a Shore D hardness of 50, a compression of 64 and a COR of 0.765. The balls passed the guillotine cut test with no visible indentation or damage and the scuff test with almost no markings. Commercially available balls all exhibited a scuff ranking of 3 or higher.

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Example 5

The procedure of Example 4 was repeated except that no peroxide was used and the resultant balls were irradiated with a 6 megarad dosage. When subject to the cut and scuff tests the balls gave results substantially the same as the balls of Example 4. After treatment the balls had a Shore D hardness of 45.

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As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above described will become readily apparent without departure from the spirit and scope of the invention, the scope of which is defined in the appended claims.

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Example 6 (Prophetic)

The formulation of Example 1 is prepared with the exception that 1.6 parts by weight of peroxide curing agent is also added. The composition was blended in a Banbury® mixer, formed into a sheet and chopped into granules. The chopped granules, 6.7 grams, were placed in female hemisphere molds and premolded under 5 tons of pressure for 12 minutes with heating up to 215°F using a female cavity of 1.680" diameter and a 1.624" male cavity. The resultant shells were molded around a 1.680" Z-Balata" solid core in a dimpled cavity mold at 10

tons of pressure for 8 minutes to a maximum mold temperature of 313°F.

Example 7 (Prophetic)

The formulation of Example 2 is prepared with the exception that 5 0.8 parts of peroxide curing agent is also added. The composition was blended in a Banbury® mixer, formed into a sheet and chopped into granules. The chopped granules, 6.7 grams, were placed in female hemisphere molds and premolded under 5 tons of pressure for 12 minutes with heating up to 215°F using a female cavity of 1.680" 10 diameter and a 1.624" male cavity. The resultant shells were molded around a 1.680" Z-Balata" solid core in a dimpled cavity mold at 10 tons of pressure for 8 minutes to a maximum mold temperature of 313°F.

Claims:

1. A game ball having a center and a cover, the cover comprised predominantly of a non-ionomer resin having a sufficient degree of peroxide induced covalent crosslinking to impart to the cover improved resistance to at least one of scuffing and cutting, the resin being selected from the group consisting of acid copolymers and terpolymers, polyamides, block copolymers, ethylene propylene elastomers, polyamide block copolymers and syndiotactic resins, scuff and cut resistance being in the range of about 1 - 2.
2. The game ball according to claim 1, wherein the ball is a golf ball and the degree of covalent crosslinking is sufficient to impart to the ball a PGA compression which is at least 5% harder than the PGA compression of a golf ball with a cover having a substantially identical composition but which does not have a substantial degree of covalent crosslinking.
3. The game ball according to claim 1, wherein the peroxide is a dialkyl peroxide.
4. The game ball of claim 1 wherein the peroxide is 1,1-di(t-butylperoxy)3,3,5-trimethyl cyclohexane.
5. The game ball according to claim 1, wherein the degree of covalent crosslinking is sufficient to impart to the ball a coefficient of restitution which is at least 0.50% greater than a coefficient of restitution of a ball with a cover having a

substantially identical composition but which does not have peroxide-induced covalent crosslinking.

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6. The game ball according to claim 1, wherein the degree of covalent crosslinking is appropriate to impart to the cover a Shore D hardness which is no more than about 10% greater than the Shore D hardness of a cover having a substantially identical composition but which does not include a substantial degree of covalent crosslinking.
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7. The game ball according to claim 1, wherein the cover has a Shore D hardness of about 70 or less.
8. The game ball according to claim 1, wherein the non-ionomeric material is an ethylene propylene diene monomer.
9. The game ball according to claim 1, wherein the non-ionomeric material is a polyamide.
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10. The game ball according to claim 1, wherein the non-ionomeric material is a block copolymer.
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11. A golf ball having a core and a cover, the cover comprised predominantly of a non-ionomer resin having a sufficient degree of peroxide induced covalent crosslinking to impart to the cover improved resistance to at least one of scuffing and cutting, the resin being selected from the group consisting of acid copolymers and terpolymers, polyamides, block copolymers, ethylene propylene elastomers, polyamide block copolymers and

syndiotactic resins, scuff and cut resistance being in the range of about 1 - 2.

12. The golf ball according to claim 11, wherein the non-ionomeric material is an ethylene propylene diene monomer.
- 5 13. The golf ball according to claim 11, wherein the peroxide is a dialkyl peroxide.
14. The game ball of claim 11 wherein the peroxide is 1,1-di(t-butylperoxy)3,3,5-trimethyl cyclohexane.
- 10 15. The golf ball according to claim 11, wherein the degree of covalent crosslinking is sufficient to impart to the ball a coefficient of restitution which is at least 0.50% greater than a coefficient of restitution of a ball with a cover having a substantially identical composition but which does not have peroxide-induced covalent crosslinking.
- 15 16. The golf ball according to claim 11, wherein the degree of covalent crosslinking is appropriate to impart to the cover a Shore D hardness which is no more than about 10% greater than the Shore D hardness of a cover having a substantially identical composition but which does not include a substantial degree of covalent crosslinking.
- 20 17. The golf ball according to claim 11, wherein the cover has a Shore D hardness of about 70 or less.

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18. A golf ball having a core and a cover, the cover comprised predominantly of a non-ionomer resin, having a degree of peroxide-induced covalent crosslinking which is sufficient to substantially improve the resistance of the cover to at least one of scuffing and cutting while resulting in a cover hardness (Shore D) which is no more than about 5.0 % higher than the Shore D hardness of a cover which is substantially identical in composition but does not contain covalent crosslinking.

Abstract of the Disclosure

Disclosed herein is a game ball and method for making the same. The game ball has a non-ionomeric cover which has been crosslinked by incorporating a dialkyl peroxide in the polymer mix prior to molding. The game ball cover is superior in at least one of cut resistance and scuff resistance to a conventional cover that does not have covalent crosslinks but is otherwise substantially identical in composition. The game ball cover of the invention is particularly useful for improving the durability of golf balls to be struck with sharp-grooved clubs. The peroxide may be omitted and the cover crosslinked using post formation irradiation.

COMBINED DECLARATION AND POWER OF ATTORNEY
(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type:

<p><input type="checkbox"/> original</p> <p><input type="checkbox"/> design</p> <p><input type="checkbox"/> supplemental</p>	<p><input type="checkbox"/> divisional</p> <p><input type="checkbox"/> continuation</p> <p><input checked="" type="checkbox"/> continuation-in-part (C-I-P)</p>
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☐ national stage of PCT,

INVENTORSHIP IDENTIFICATION

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor (If only one name is listed below) or an original, first and joint inventor (If plural names are listed below) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

Title Of Invention: Method of Improving Scuff and Cut Resistance of Cover for Game Ball

SPECIFICATION IDENTIFICATION

the specification of which:

- (a) ☒ **is attached hereto.**
- (b) ☐ was filed on _____, as Serial No. 08/_____ and was amended on _____.
- (c) ☐ was described and claimed in PCT International Application No. _____ filed on _____ and as amended under PCT Article 19 on _____.

ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and

☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119(a)-(d))

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

- (d) ☒ no such applications have been filed.
- (e) ☐ such applications have been filed as follows

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN)
PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			YES NO

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S) (34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER

FILING DATE

_____/_____/_____

____/____/____

CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S) UNDER 35 U.S.C. 120

I hereby claim the benefit, under Title 35, United States Code, § 120, of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information,

XX that is material to patentability as defined in 37, Code of Federal Regulations, § 1.56

XX and that is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable examiner would consider it important in deciding whether to allow the application to issue as a patent, that occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application.

In compliance with this duty, there is attached an information disclosure statement, in accordance with 37 C.F.R. 1.98.

**PRIOR U.S. APPLICATION OR PCT INTERNATIONAL APPLICATIONS
DESIGNATING THE U.S. FOR BENEFIT UNDER 35 USC 120:**

U.S. APPLICATIONS

Status (check one)

U.S. APPLICATIONS	U.S. FILING DATE	Patented	Pending	Abandoned
09 / 236,848	January 25, 1999		X	
08 / 942,653	October 2, 1997	X		
08 / 595,898	February 6, 1996			X

**ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

POWER OF ATTORNEY

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Diane F. Covello	Registration No. 34164
L. James Ristas	Registration No. 28,663
Guy D. Yale	Registration No. 29,125
Richard H. Berneike	Registration No. 21,126

___ hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
 ___ Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO**DIRECT TELEPHONE CALLS TO:**

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DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)**Full name of sole or first inventor**

<u>R.</u>	<u>Dennis</u>	<u>Nesbitt</u>
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature X R. Dennis Nesbitt
 Date X 11/22/99 Country of Citizenship U. S. A.
 Residence 70 Deer Path Lane, Westfield, Massachusetts 01085
 Post Office Address Same

X This declaration ends with this page.